



UNITED STATES PATENT AND TRADEMARK OFFICE

H.7

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,366	03/19/2004	Kyle K. Kirby	2269-6208US (03-0852.00/U)	9222
24247	7590	01/05/2007	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			PHAM, THANHHA S	
			ART UNIT	PAPER NUMBER
			2813	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/05/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/804,366	Applicant(s) KIRBY ET AL.	
	Examiner Thanhha Pham	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 November 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 10-19, 21-28, 45-55 and 57-67 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 10-19, 21-28, 45-55, 57-67 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office Action is in response to Applicant's Amendment dated 11/06/2006.

Claim Objections

1. Claims 11-17, 19, 22-28, 46-54, 55, 57-63 are objected to because of informalities. Appropriate corrections are required to clarify scope of claims.

► With respect to claims 11-17, limitations of "a silicon layer", "a semiconductor substrate", "an etch solution", and "at least one organic solution" referring back and previously cited independent claim should be respectively changed to "the silicon layer", "the semiconductor substrate", "the etch solution", and "the at least one organic solution" to clarify scopes of claims.

► With respect to claims 19, 22-28, limitations of "a silicon substrate having a HAZ", "at least one of an exposed metal layer, an exposed oxide layer and an exposed nitride layer", "an etch solution", and "at least one organic solvent" referring back and previously cited in independent claim should be respectively changed to "the silicon substrate having the HAZ", "the at least one of the exposed metal layer, the exposed oxide layer and the exposed nitride layer", "the etch solution", and "the at least one organic solvent" to clarify scope of claims.

► With respect to claims 46-54, limitations of "an etch solution" and "at least one organic solution" referring back and previously cited independent claim should be

Art Unit: 2813

respectively changed to "the etch solution" and "the at least one organic solution" to clarify scopes of claims.

- ▶ With respect to claim 55, line 7, "an etch solution comprising tetramethylammonium hydroxide ("TMAH") and at least one organic solvent" should be change to "a first etch solution comprising tetramethylammonium hydroxide (TMAH) and at least one organic solvent" to clarify scope of claim. (see dependent claims cited "first etch solution" – consistent claimed language should be used to clarify scope of claims).
- ▶ With respect to claims 57-63, of "a first etch solution" and "at least one organic solution" referring back and previously cited independent claim should be respectively changed to "the first etch solution" and "the at least one organic solution" to clarify scopes of claims.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. **Claims 10-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Bolle et al [US 6,912,081].**

Art Unit: 2813

Bolle et al (figs 1-15, cols 1-7) discloses the claimed method of selectively etching silicon layer on a semiconductor substrate comprising:

exposing a silicon layer (101, fig 1, col 4 lines 55-67) on a semiconductor substrate (101) to an etch solution comprising a tetramethylammonium hydroxide (TMAH) and at least one organic solvent (nonylphenol ethoxy ether), the at least one organic solvent comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group that dissociates and forms at least one hydroxyl ion (nonylphenol ethoxy ether dissociates and form at least hydroxyl ion), the at one organic solvent (phenol) selected from the group consisting of isopropanol, butanol, hexanol, phenol, glycol, glycerol, ethylene glycol, propylene glycol, glycerine and mixture thereof, and removing the silicon layer without removing at least one of an exposed oxide layer, an exposed nitride layer, and an exposed polyimide layer also present on the semiconductor substrate (figs 1-2, col 4 lines 55-67: *silicon layer 101 removed without removing at least one of the exposed layer 103*).

3. Claims 18-19, 21-28, 45-55, 57-64 and 67 are rejected under 35 U.S.C. 102(e) as being anticipated by Rigg et al [US 2005/0104228].

► With respect to claims 18-19, 21-28, Rigg et al (figs 3's-5's, text [0001]-[0051]) discloses the claimed method of removing a heat-affected zone ("HAZ") on a semiconductor substrate, comprising:

providing a silicon substrate (212, fig 3D, text [0021]-[0022], [0033]-[0034]) having a HAZ (slag and byproducts caused by laser cut) wherein providing the silicon substrate (212) having the HAZ comprising forming the HAZ by laser ablation;

Art Unit: 2813

removing the HAZ without removing at least one of an exposed oxide layer and an exposed nitride layer (fig 3D & 5A, text [0034] & [0041]: exposed layer 354 is not removed) present on the silicon substrate (212) by exposing the silicon substrate to an etch solution comprising a tetramethylammonium hydroxide (TMAH) and at least one organic solvent (propylene glycol), the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group (propylene glycol) that dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion), the etch solution inherently comprising approximately 6% TMAH and 94% approximately propylene glycol; and

removing at least a portion of the silicon substrate other than within the HAZ with the etch solution (the etch solution inherently removing at least a portion of the silicon substrate).

► With respect to claims 45-54, Rigg et al (figs 3's-5's, text [0001]-[0051]) discloses the claimed method of forming an aperture in a through-wafer interconnect comprising:

exposing a silicon substrate (212, fig 3D, text [0021]-[0022], [0033]-[0034]) to a laser beam to form an aperture, wherein the laser beam forms a heat-affected zone (HAZ, slag and byproducts caused by laser cut) on to silicon substrate;

exposing the silicon substrate to an etch solution comprising tetramethylammonium hydroxide (TMAH) and at least one organic solvent (text [0034]), the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic solvent having at least one hydroxyl group (propylene glycol) that

Art Unit: 2813

dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion), the etch solution inherently comprising approximately 6% TMAH and 94% approximately propylene glycol;

removing the HAZ without removing at least one of an exposed oxide layer, an exposed nitride layer, and an exposed polyimide layer (fig 3D & 5A, text [0034] & [0041]: exposed layer 354 is not removed) present on the silicon substrate (212);

removing the silicon substrate with the etch solution (TMAH and propylene glycol inherently etching silicon substrate) to enlarge a diameter of the aperture ; and

filling the aperture with a conductive material (576, fig 5C) to form a through-wafer interconnect.

► With respect to claims 55, 57-64 and 67, Rigg et al (figs 3's-5's, text [0001]-[0051]) discloses the claimed method of forming an aperture in a through-wafer interconnect comprising:

exposing a silicon substrate (212, fig 3D, text [0021]-[0022], [0033]-[0034]) to a laser beam to form an aperture, wherein the laser beam forms a heat-affected zone (HAZ, slag and byproducts caused by laser cut) on to silicon substrate;

removing the HAZ without removing at least one of an exposed oxide layer and an exposed nitride layer present on the silicon substrate (fig 3D & 5A, text [0034] & [0041]: exposed layer 354 is not removed) by exposing the silicon substrate to a first etch solution comprising tetramethylammonium hydroxide (TMAH) and at least one organic solvent (text [0034]), the at least one organic solvent (propylene glycol) comprises at least one hydroxyl group, the at least one organic solvent having at least

Art Unit: 2813

one hydroxyl group (propylene glycol) that dissociates and forms at least one hydroxyl ion (propylene glycol dissociates and form at least hydroxyl ion), the etch solution inherently comprising approximately 6% TMAH and 94% approximately propylene glycol;

removing at least a portion of the silicon substrate with a second etch solution to enlarge a diameter of the aperture (TMAH and propylene glycol inherently etching silicon substrate would enlarge a diameter of the aperture);

forming a passivation layer (558, fig 5A) on sidewalls of the aperture before filling the aperture with conductive material; and

filling the aperture with a conductive material (576, fig 5C) to form a through-wafer interconnect.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 14-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bolle et al [US 6,912,081] in view Starzynski [US 2005/0065050].

► With respect to claim 15, TMAH and propylene glycol is a known mixture for etching silicon. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v.*

Art Unit: 2813

Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious).

► With respect to claims 15-17, claimed range concentration of TMAH and propylene glycol are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious.

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

See also In re Waite 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66

Art Unit: 2813

USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

5. Claims 65-66 are rejected under 35 U.S.C. 103(a) as being unpatentable Rigg et al [US 2005/0104228] in view of Takehiko et al [JP 06-041770].

Watkins et al substantially discloses the claimed method except using the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent.

However, Takehiko et al disclose the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent for cleaning silicon.

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process of Rigg et al by using the second etch solution comprising ammonium fluoride, phosphorous acid, water, hydrogen peroxide and at least one organic solvent for cleaning silicon substrate to provide a smooth silicon surface without contaminant.

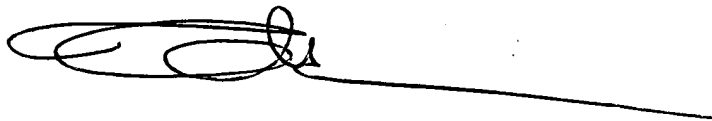
Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

Art Unit: 2813

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, consisting of a series of loops and a long horizontal stroke extending to the right.

TSP

**THANHHA S. PHAM
PRIMARY EXAMINER**